The opinion in support of the decision being entered today was ***not*** written for publication and is ***not*** binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte DAVID J. COOPERBERG, VAHID VAHEDI, DOUGLAS RATTO, HARMEET SINGH and NEIL BENJAMIN

Appeal No. 2006-0290
Application 10/024,208

ON BRIEF

Before KIMLIN, WARREN and TIMM, *Administrative Patent Judges.*

WARREN, *Administrative Patent Judge.*

Decision on Appeal

This is an appeal under 35 U.S.C. § 134 from the decision of the examiner finally rejecting claims 1 through 11, 13 through 15 and 39 through 61, all of the claims in the application.

Claim 1 illustrates appellants' invention of a plasma processing system, and is representative of the claims on appeal:

1. A plasma processing system comprising:

a plasma processing chamber;

a vacuum pump connected to the processing chamber;

a substrate support on which a substrate is processed within the processing chamber;

a dielectric member having an interior surface facing the substrate support, wherein the dielectric member forms a wall of the processing chamber;

a gas injector extending through the dielectric member, the gas injector comprising a body including an axial end surface exposed within the processing chamber, a side surface extending axially from the axial end surface, and a plurality of gas outlets including at least one on-axis outlet in the axial end surface and a plurality of spaced-apart off-axis outlets in the side surface;

a common gas supply in fluid communication with a first gas line and a second gas line, the first gas line being in fluid communication with the on-axis outlet but not with the off-axis outlets and the second gas line being in fluid communication with the off-axis outlets but not with the on-axis outlet;

flow controllers operable to supply process gas from the common gas supply at flow rates that are independently varied between the on-axis outlet and the off-axis outlets into the processing chamber; and

an RF energy source which inductively couplers RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate.

The references relied on by the examiner are:

Hassan et al. (Hassan)	4,270,999	Jun. 2, 1981
Goodyear et al. (Goodyear)	5,532,190	Jul. 2, 1996
Arami et al. (Arami)	5,958,140	Sep. 28, 1999
Ballance et al. (Ballance)	6,090,210	Jul. 18, 2000
Powell et al. (Powell)	6,287,643	Sep. 11, 2001
Murugesh et al. (Murugesh)	6,450,117	Sep. 17, 2002 (filed Aug. 7, 2000)
Chang	WO 99/57747 (published World Intellectual Property Organization Application)	Nov. 11, 1999
Ni et al. (Ni)	WO 00/41212 (published World Intellectual Property Organization Application)	Jul. 13, 2000

The examiner has advanced the following grounds of rejection on appeal:

claims 1 through 7, 9, 11, 13, 14, 39, 41 through 50 and 56 through 61 stand rejected under 35 U.S.C. § 103(a) as being obvious over Chang in view of Murugesh and Arami or Goodyear or Ballance (answer, pages 4-9);

claims 8, 10 and 40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang in view of Murugesh and Arami or Goodyear or Ballance as applied to claims 1 through 7, 9 11, 13, 14, 39, 41 through 50 and 56 through 61, further in view of Ni (answer, pages 9-10);

claim 15 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang in view of Murugesh and Arami or Goodyear or Ballance as applied to claims 1 through 7, 9 11, 13, 14, 39, 41 through 50 and 56 through 61, further in view of Powell (answer, pages 10-11); and

claims 51 through 55 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang in view of Murugesh and Arami or Goodyear or Ballance as applied to claims 1 through 7, 9 11, 13, 14, 39, 41 through 50 and 56 through 61, further in view of Hassan (answer, pages 11-12),

Appellants argue claims 1 through 4, 6, 11, 13, 14, 41 through 43, 47, 48, 50, 56, 60 and 61 as a group with respect to the first ground of rejection (brief, page 13); each of claims 5 and 39 with respect to the first ground of rejection (brief, pages 18-19); claims 7, 44 and 57 as a group with respect to the first ground of rejection (brief, page 19); claims 9, 45, 49 and 58 as a group with respect to the first ground of rejection (brief, page 21); claims 8, 10 and 40 as a group with respect to the second ground of rejection (brief, page 23); claim 15 with respect to the third ground of rejection (brief, page 24); and claims 51 through 55 as a group with respect to the fourth ground of rejection (brief, page 23). Thus, we decide this appeal based on independent claims 1, 7, 9, 10, 41 and 42 and dependent claims 5, 8, 15, 39 and 51 as representative of the grounds of rejection and appellants' groupings of claims. 37 CFR § 41.37(c)(1)(vii) (September 2004).

We the affirm grounds of rejection with respect with respect to claims 1 through 6, 8, 11, 13 through 15, 39, 41 through 43, 47, 48, 50, 51, 54 through 56, 60 and 61; reverse the first and fourth grounds of rejection with respect to claims 7, 9, 44, 45, 49, 52, 53, 57 and 58; and reverse *pro forma* the first, second and third grounds of rejection with respect to claims 10, 40, 46 and 59.

However, we designate our affirmance of claim 8 in the second ground of rejection as involving a new grounds of rejection pursuant to 37 CFR § 41.50(b) (2005) because we rely on the combined teachings of Ni, Chang, Murugesh, Arami, Goodyear and Ballance in a manner materially different from that of the examiner, and further include in this new ground of rejection claims 1 through 9, 11, 13 through 14, 39, 41 through 45, 47 through 50, 56 through 58, 60 and 61 which were not previously rejected under § 103(a) over this combination of references. In the same respects, we enter new grounds of rejection under § 103(a) of claim 15 over this same combination of references and Powell, and of claims 51 through 55 over this same combination of references and Hassan, thus adding Ni to the references applied to these claims by the examiner. We further enter a new ground of rejection of claims 10, 40, 46 and 59 under 35 U.S.C. § 112, second paragraph. *See generally, In re Eynde*, 480 F.2d 1364, 1370-71,

178 USPQ 470, 474-75 (CCPA 1973); Manual of Patent Examining Procedure § 1213.02 (8th ed., Rev. 3, August 2005).

Rather than reiterate the respective positions advanced by the examiner and appellants, we refer to the answer and to the brief and reply brief for a complete exposition thereof.

Opinion

In order to review the examiner's application of prior art to independent claims 1, 7, 9, 10, 41 and 42 and dependent claims 5, 8, 15, 39 and 51, we first interpret these claims by giving the terms thereof the broadest reasonable interpretation in their ordinary usage in context as they would be understood by one of ordinary skill in the art in light of the written description in the specification unless another meaning is intended by appellants as established in the written description of the specification, and without reading into the claims any limitation or particular embodiment disclosed in the specification. *See, e.g., In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364, 70 USPQ2d 1827, 1830 (Fed. Cir. 2004); *In re Morris*, 127 F.3d 1048, 1054-55, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997); *In re Zletz*, 893 F.2d 319, 321-22, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989).

The issues in this appeal involve the gas injector and its common gas supply having flow controllers, as specified for the claimed plasma processing system in each of the independent claims. Referring to specification **Figs. 1** and **2a-c** (see specification, e.g., pages 10-13), gas injector **22** specified by independent claim 1 extends through and below the lower surface of dielectric member **20** at least to the extent that the plurality of spaced-apart off-axis outlets **26** in the side surface extending axially from the axial end surface, are within processing chamber **10**, wherein the axial end surface contains at least one on-axis outlet **24**. The axial orientation of the outlets is relative to the axis of the injector. The common gas supply line **32** branches into a first line containing flow controller **36***b* in fluid communication with on-axis outlet **24**, and a second line containing flow controller **36***a* in fluid communication with off-axis outlets **26**. Dependent claim 5 specifies that injector **22** of claim 1 is cylindrical and off-axis outlets **26** are circumferentially spaced apart. Dependent claim 8 specifies that injector **22** of claim 1 is removably mounted in dielectric member **20** and centrally supplies process gas to processing chamber **10**. Dependent claim 15 specifies that injector **22** of claim 1 has an electrically

conducting shield **40**. Dependent claim 39 specifies that injector **22** of claim 1 has on-axis outlet **24** and off-axis outlets **26** "oriented at different angles relative to an exposed surface of the substrate" **13**. Dependent claim 51 specifies on-axis outlet **24** and off-axis outlets **26** of injector **22** of claim 1 include an interior orifice which provides sonic or supersonic flow.

The gas injector **22** specified by independent claim 7 extends through and below the lower surface of dielectric member **20** at least to the extent that the off-axis outlets **26** in the conical side surface of the axial end are within processing chamber **10**, and the planar axial end face has an on-axis outlet **24**, wherein on-axis outlet **24** receives process gas from central passage **25**, and off-axis outlets **26** receive process gas from an annular passage surrounding central passage **25**, the process gas flow rates in the passages being independent, the processing gas supplied by a common gas supply specified in the same manner as in claim 1. The axial orientation of the outlets is relative to the axis of the injector.

The gas injector **22** specified by independent claim 42 extends through and below the lower surface of dielectric member **20** at least to the extent that second gas outlets **26** in the side surface of the axial end are within processing chamber **10**, wherein first gas outlet **24** in the axial end surface is in fluid communication with first gas passage **25** and a first gas inlet, and second gas outlets **26** are in fluid communication with a second gas passage and a second gas inlet, with common gas supply **32** in fluid communication with the passages through containing flow controllers **36***a* and **36***b*. There is no limitation on the orientation of the first and second gas outlets.

The gas injector **22** specified by independent claim 9 extends through and below the lower surface of dielectric member **20** at least to the extent that outlets in the distal end of the injector are within processing chamber **10**, wherein the injector has at least one on-axis outlet **24** injecting gas in an axial direction perpendicular to a plane parallel to an exposed surface of the substrate **13**, and circumferentially spaced apart off-axis outlets **26** injecting gas at an acute angle relative to said plane, the processing gas supplied by a common gas supply specified in the same manner as in claim 1, and the gas flow rates between at least some of the outlets can be independently varied. There is no limitation on the placement of the on-axis outlet and the circumferentially spaced apart off-axis outlets in the distal end of the injector.

The gas injector **22** specified by independent claim 41 extends through and below the lower surface of dielectric member **20** at least to the extent that a plurality of gas outlets in a distal end of the injector are disposed within processing chamber **10** below the lower surface of dielectric member **20**, and a common gas supply **32** branches into a first gas line **36***b* and a second gas line **36***a*, the gas lines being in fluid communication with respective sets of outlets, with the flow rates of the gas lines independently adjusted by flow controllers. There is no limitation on the placement of the two sets of outlets in the distal end of the injector or on the orientation of the outlets.

The gas injector **22** specified by independent claim 10 extends through and below the lower surface of dielectric member **20** at least that a plurality of gas outlets in a single distal end of the injector are disposed within processing chamber **10** below the lower surface of dielectric member **20**, and the gas flow rates between at least some of the outlets can be independently varied. The injector is removably mounted in dielectric member **20** with a vacuum seal therebetween. There is *no* limitation on the placement of the outlets in the distal end of the injector or on the orientation of the outlets. Thus, there is no antecedent basis for specifying the common gas supply for the injector in terms of gas lines in fluid communication with "the on-axis outlet" and with "the off-axis outlets" of certain orientation, as indeed, according to the fifth clause of claim 10, all of the outlets can be on-axis or can be off-axis rather than mixed as required by the sixth clause thereof.

On this basis we determine that, *prima facie*, claim 10 and claims 40, 46 and 59 dependent thereon fail to particularly point out and distinctly claim the subject matter which applicants regard as the invention and thus do not comply with the requirements of 35 U.S.C. § 112, second paragraph. Therefore, pursuant to 37 CFR § 41.50(b) (2005), we enter a new ground of rejection of claims 10, 40, 46 and 59 under 35 U.S.C. § 112, second paragraph.

Accordingly, the metes and bounds of claims 10, 40, 46 and 59 are unclear and indefinite to the extent that it is impossible to ascertain the propriety of the examiner's grounds of rejection of these claims under 35 U.S.C. § 103(a), and therefore, we reverse the grounds of rejection with respect to claims 10, 40, 46 and 59 *pro forma*. *See In re Wilson*, 424 F.2d 1382, 1385,

165 USPQ 494, 496 (CCPA 1970); *In re Steele*, 305 F.2d 859, 862-63, 134 USPQ 292, 295-96 (CCPA 1962).

We find that Chang would have disclosed to one of ordinary skill in this art a plasma processing system illustrated in **FIGs. 1** and **7**, in which gas delivery system **46** includes a gas injector that extends through dielectric member **50** to communicate with plasma processing region **52** of process chamber **38**. The injector includes a central passage connecting film forming $TiCl_4$ gas source **100***a* via flow controller **120***a* and gas delivery lines **92** with top nozzle **96** which is an on-axis outlet in the distal end of the injector. The injector further has an annular passage surrounding the central passage, which passage connects plasma forming H_2 and Ar gas sources **100***b* and **100***d* via flow controllers **120***b* and **120***c* and gas delivery lines **92** to top vent **98** that "is an annular opening," that is, outlet, "around the top nozzle 96." We find that one of ordinary skill in this art would have found from **FIGS. 1** and **7** that only the structure forming the interior surface of top vent **98** and the exterior surface of nozzle **96** and acting to shape the gas flowing through top vent **98**, extends below the lower surface of dielectric member **50** into plasma processing region **52**. Chang would have disclosed that "top nozzle 96 and top vent 98 allow independent control of top and side flows of the gases, which improves film uniformity." See, e.g., pages 6-10 and 18-19.

We find that Murugesh would have disclosed to one of ordinary skill in this art, as illustrated in **FIGs. 1A** and **3**, a substrate processing chamber **30** wherein a process gas is provided through first gas distributor **65** and a cleaning gas is provided through second gas distributor **215**, wherein the two gas distributors can be combined into a single injector. In **FIG. 1A**, second gas distributor **215** is separate and located in ceiling **55** of process chamber **30**, and has outlets **247***a,b*, wherein outlet **247***a* includes baffle **248** having upper surface **251** that directs "cleaning gas preferentially across the ceiling **55** of the chamber **30** in the upper region **269** . . . to pre-selected regions . . . where the cleaning of process residue is needed," and "[a]lternatively, the angle made between the upper surface **251** and the substrate **25** may be set such that the angle is greater than or less than 90° . . . [and] chosen such that the deflection of the gas off of the upper surface **251** will direct it to the pre-selected regions or surfaces." In **FIG. 3**, first gas distributor **65** and second gas distributor **215** "are combined in a single structure,"

wherein a gas supply line with flow controller **80** provides process gas through a central passage to "first outlets **85**" and another gas supply line **170** with flow controller **120** provides cleaning gas through an annular passage to "second outlets **247**." We find that one of ordinary skill in this art would have reasonably inferred from **FIG. 3** that the side surface extending axially from the axial end surface is cylindrical and has second outlets **247** circumferentially spaced apart therein, particularly in view of the shape and distribution of outlets **247** in **FIGs. 2A-B**.[1] See, e.g., col. 1, l. 65, to col. 2, l. 4, col. 3, ll. 46-45, col. 5, ll. 27-54, col. 6, ll. 21-60, and col. 7, l. 65, to col. 8, l. 7.

We find that Arami would have disclosed to one of ordinary skill in this art, as illustrated in **FIGs. 2** and **5**, an apparatus having a "shower head section **35** is divided by partitioning walls **36***A* and **36***B* arranged concentrically, thereby forming three gas chambers **37***A* to **37***C*" that are independently connected to a process gas supply pipe **38,39,40** with a flow controller **44***A*,**44***B*,**44***C*, to which in turn are connected to a gas supply source **41,42,43**, such that the process gas supply can be individually managed to the three sections of shower head section **35**. See, e.g., col. 2, ll. 16-20, col. 4, ll. 31-57, and col. 10, ll. 29-44.

We find that Goodyear would have disclosed to one of ordinary skill in this art, as illustrated in **FIG. 1**, an apparatus for the manufacture of large-area devices, that has a perforated gas-feeding electrode **12** which, with gas supply means **21** and **22**, "form a so-called 'shower head,'" wherein first supply line **21** feeds central area **12***a* and second supply line **22** feeds an annular peripheral area **12***b*. Goodyear would have taught that problems arise where an identical gas composition is fed via the lines **21** and **22** and one of the gases in the composition is depleted at a faster rate, the solution to which is the capability to independently adjust the gas supply to the areas **12***a*,**12***b* of perforated electrode **12**. Thus, the respective gas supply means **21** and **22** have separate primary and second gas supplies with valves and flow meters **26***a*,**23***a*, **24***a*,**55,56** and **26***b*,**23***b*,**24***b*,**55,56**. which permit independent control of the process gas supplied. We find

[1] It is well settled that a reference stands for all of the specific teachings thereof as well as the inferences one of ordinary skill in this art would have reasonably been expected to draw therefrom, *see In re Fritch*, 972 F.2d 1260, 1264-65, 23 USPQ2d 1780, 1782-83 (Fed. Cir. 1992); *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968), presuming skill on the part of this person. *In re Sovish*, 769 F.2d 738, 743, 226 USPQ 771, 774 (Fed. Cir. 1985).

that one of ordinary skill in this art would have reasonably inferred from the teachings of Goodyear that the process gas supplied to each of areas **12***a*,**12***b* can be of the same composition. See, e.g., col. 1, ll. 4-18, col. 2, ll. 9-29, col. 4, ll. 10-64, col. 5, ll. 14-59, and col. 7, ll. 41-65.

We find that Ballance would have disclosed to one of ordinary skill in this art, as illustrated in **FIGs. 5** and **8**, a multi-zone gas flow control showerhead **100** with multiple gas injection holes, for a process chamber wherein a gas source delivers gas to inner hole array **102** through inlet port **103** and a second gas source delivers gas to outer hole array **104** through inlet port **105**, which provides independent control over the flow rates through the two gas distribution hole arrays. In **Fig. 8**, a showerhead **300** has a common gas supply line from gas supply **314** in fluid communication with gas line **312** having flow controller **318** for central circular chamber **308** and with gas line **310** having flow controller **316** for annular outer chamber **306**, wherein gas supply **314** is "pressurized gas . . . or gases." Ballance would have disclosed that the distribution of gas through the injector is within the ordinary skill in the art. See, e.g., col. 1, ll. 49-61, col. 6, l. 37, to col. 7, l. 32, and col. 8, ll. 35-56.

We find that Ni would have disclosed to one of ordinary skill in this art, as illustrated in **FIGs. 1** and **3a-c**, an injector **22** extends through and below the lower surface of dielectric member **20** at least to the extent that a plurality of gas outlets in the axial end surface are within processing chamber **10**, and is connected to gas supply **23**. Ni would have taught that the injector can have outlets in different configurations, including a center outlet or no outlet in the axial end surface, and a plurality of angled gas outlets extending at an acute angle to the axial direction as well as relative to a plane parallel to the surface of the substrate, and are capable of injecting gas at subsonic, sonic and supersonic velocity (e.g., pages 5-6 and 20). The injector can be removably mounted in dielectric member **20** with an O-ring providing a vacuum seal between the injector and dielectric member **20** (e.g., pages 6 and 13-14). The gas injector can be cylindrical with the number and injection angle of the outlets selected as required (page 9). In **FIGs. 3a-c**, injector **22** has cylindrical body **40** with central bore **44**, a plurality of outlets **46** in the lower axial and O-ring grooves **48,50**, wherein outlets **46** are spaced apart by 90° and extend at an acute angle to the axial direction, that is, off-axis, and as mounted in dielectric member **20**, to a plane parallel to the surface of the substrate (page 11). In an embodiment, the cylindrical injector has 8

outlets spaced 45° apart located adjacent the outer periphery of the axial end and can have an outlet in the center of the axial end, wherein the 8 injectors can be angled to the central axis, that is, off-axis, or can extend axially, that is, on-axis (page 13). The number and arrangement of outlets can be selected as desired, including "the location of the gas outlets such as on the axial end and/or along the sides of the gas injector" (page 14), and the distal end off the injector should have no sharp corners in order to reduce local electric field enhancement near the tip (page 20).

Based on the substantial evidence in the applied references, we agree with the examiner that the combined teachings of Chang, Murugesh, Arami, Goodyear and Ballance would have reasonably suggested to one of ordinary skill in this art to replace the injector of Chang, containing central and annular passages joining outlets to separate gas sources, with the injector of Murugesh, containing central and annular passages joining outlets to separate gas sources, in the reasonable expectation of interchanging gas injectors having the same and similar construction which can be connected to different gas supply lines.

We also agree with the examiner that the combined teachings of these references would have further reasonably suggested to this person that the gas supplied to each of the central and annular passages and respective outlets in the injector of Murugesh can be adjusted with respect to flow with flow controllers and to composition with source selection, in the reasonable expectation of obtaining any desired flow and composition. Indeed, each of Chang, Murugesh, Arami, Goodyear and Ballance would have taught the selection of gas sources using the appropriate gas lines having flow controllers to supply gas of desired composition and flow to separate sets of outlets through central and annular passages. In this respect, as we found above, Goodyear recognized the problem of a gas composition containing an ingredient which is easily depleted but would not have taught that the gas composition supplied to the separate sets of outlets must be different, and Ballance would have made clear in **FIG. 8** thereof and accompanying disclosure that gas from a common gas supply line can be supplied to different sets of outlets in the same injector using first and second gas lines with associated flow controllers in fluid communication with first and second passages.

Accordingly, we determine that one of ordinary skill in this art routinely following the combined teachings of Chang, Murugesh, Arami, Goodyear and Ballance would have reasonably

arrived at the claimed plasma processing system encompassed by appealed claims 1, 5, 39, 41 and 42, including each and every limitation arranged as required therein, without recourse to appellants' specification. Indeed, we find that the injector of Murugesh **FIG. 3** satisfies the requirements for the gas injector as specified in each of claims 1, 5, 39, 41 and 42 because the cylindrically shaped body thereof can extend through the dielectric member of Change to expose below the surface of the dielectric member an axial or distal end surface having an on-axis outlet **85** in fluid communication with a central or first passage, and a side surface extending axially from the axial end surface toward the interior surface of the dielectric member, having circumferentially spaced apart off-axis outlets **247** in fluid communication with an annular or second passage, wherein the on-axis and off-axis outlets are oriented at different angles relative to an exposed surface of the substrate. *See In re Dow Chem. Co.*, 837 F.2d 469, 473, 5 USPQ2d 1529, 1531-32 (Fed. Cir. 1988) ("The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that [the claimed process] should be carried out and would have a reasonable likelihood of success viewed in light of the prior art. [Citations omitted] Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure."); *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881-82 (CCPA 1981)("The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art."); *In re Siebentritt*, 372 F.2d 566, 567-68, 152 USPQ 618, 619 (CCPA 1967) (express suggestion to interchange methods which achieve the same or similar results is not necessary to establish obviousness); *see also In re O'Farrell*, 853 F.2d 894, 903-04, 7 USPQ2d 1673, 1680-81 (Fed. Cir. 1988) ("Obviousness does not require absolute predictability of success. . . . There is always at least a possibility of unexpected results, that would then provide an objective basis for showing that the invention, although apparently obvious, was in law nonobvious. [Citations omitted.] For obviousness under § 103, all that is required is a reasonable expectation of success. [Citations omitted.]").

We are not convinced otherwise by appellants' arguments in the brief and reply brief. The thrust of the examiner's grounds of rejection is whether one of ordinary skill in this art would have modified Chang's apparatus by using the injector illustrated in Murugesh **FIG. 3**, and thus, there is no issue whether Chang's injector would satisfy the limitations of the appealed claims (brief, pages 13-14; reply brief, pages 5-8). Further, we find no evidence in the record including the disclosure of Murugesh, supporting appellants' contention that the differences in the gas supplied to the different passages and outlets in the Murugesh **FIG. 3** injector would have disclosed to one of ordinary skill in the art that this injector is dedicated to supplying a particular kind of gas (brief, page 15). Indeed, Murugesh would have taught that the cleaning gas composition can be used with different types of injectors as seen from **FIGs. 1A** through **3** thereof. We further fail to find any disclose in the combined teachings of the applied references which would have taught away from a common gas supply as claimed (brief, pages 15-17; reply brief, pages 2-3). This is because none of the references contains any disclosure which criticizes, discredits or otherwise discourages a common gas supply, and the combined teachings particularly suggest that a common gas supply to first and second gas lines leading to respective passages and sets of outlets can be used as we found above. *See In re Fulton*, 391 F.3d 1195, 1201, 73 USPQ2d 1141, 1145-46 (Fed. Cir. 2004).[2] In this same respect, appellants have not established on this record that one of ordinary skill in this art would not have been led by the combined teachings of the references to adjust the gas source and flow to separate passages and outlets of injectors (brief, pages 17-18).

With respect to claim 5, appellants have not supported their position that the Murugesh **FIG. 3** injector is not cylindrically shaped (brief, pages 18-19) when the contrary would have been apparent to one of ordinary skill in this art. With respect to claim 39, all that the claim requires is that the on-axis and off-axis outlets are oriented at different angles relative to an

[2] *See also In re Gurley*, 27 F.3d 551, 552-53, 31 USPQ2d 1130, 1131-32 (Fed. Cir. 1994) ("A reference may be said to teach away when a person of ordinary skill, upon reading the reference would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant. [Citations omitted.]").

exposed surface of the substrate, and the angles of the Murugesh **FIG. 3** injector are simply so angled (brief, page 19.).

With respect to claims 15 and 51, the examiner has further combined the teachings of Chang, Murugesh, Arami, Goodyear and Ballance with Powell with respect to an electrically conducting shield for the Murugesh **FIG. 3** injector, thus arriving at claim 15, and with Hassan with respect to an interior orifice which would provide sonic flow for the outlets of the Murugesh **FIG. 3** injector, thus arriving at claim 51. Appellants merely contend with respect to each of these grounds of rejection, that the additional applied reference does not address issues raised by appellants with respect to whether other references would have taught other claim limitations (brief, pages 24-25).

Accordingly, we have again evaluated all of the evidence of obviousness found in the combined teachings of Chang, Murugesh, Arami, Goodyear and Ballance and as further combined with Powell and with Hassan with appellants' countervailing evidence of and argument for nonobviousness in the brief and reply brief, and based thereon we conclude that the claimed invention encompassed by appealed claims 1 through 6, 11, 13 through 15, 39, 41 through 43, 47, 48, 50, 51, 54 through 56, 60 and 61 would have been obvious as a matter of law under 35 U.S.C. § 103(a). *See generally, In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984).

We do not reach the same conclusion with respect to claims 7 and 9. Appellants correctly point out that the Murugesh **FIG. 3** injector does not have conical side surfaces as required by claim 7 (brief, page 20). We cannot agree with the examiner that one of ordinary skill in this art would have found in Chang the motivation to modify the Murugesh **FIG. 3** injector (answer, page 16), because the modification of Chang is with the whole of the Murugesh **FIG. 3** injector. We further agree with appellants that there is no motivation in the applied references to adjust the off-axis outlets **247** of the Murugesh **FIG. 3** injector to inject gas at an acute angle relative to the plane parallel to the exposed surface of the substrate as required by claim 9 (brief, pages 21-22). The examiner relies on the disclosure at col. 6, ll. 56-60 (answer, pages 8 and 16). This disclosure must be considered in the context of the passage at col. 5, l. 41, to col. 8, l. 7, which

includes the teachings with respect to the angle of the upper surface **251** of baffle **248** of the second gas distributor **215** relative to substrate **25** shown in Murugesh **FIG. 1A** and described at col. 6, ll. 21-67 (*see above* p. 7). On this basis, while the angle of upper surface **251** can be less than 90° relative to substrate **25** if required to direct gas to desired areas of chamber **30**, we find no teaching which would have suggested to one of ordinary skill in this art that this angle would be an acute angle, that is, a relative sharp angle of much less than 90°. We further fail to find any disclosure with respect to the somewhat corresponding off-axis outlets **247** of Murugesh **FIG. 3** which would have suggested to this person that the angle of these outlets relative to substrate **25** is an acute angle (col. 7, l. 65, to col. 8, l. 7).

Accordingly, in the absence of a *prima facie* case of obviousness, we reverse the grounds of rejection of claims 7, 9, 44, 45, 49, 52, 53, 57 and 58.

Pursuant to 37 CFR § 41.50(b) (2005), we enter the following new grounds of rejection under 35 U.S.C. § 103(a): claims 1 through 9, 11, 13, 14, 39, 41 through 50 and 56 through 61 as unpatentable over the combined teachings of Ni, Chang, Murugesh, Arami, Goodyear and Ballance; claim 15 as unpatentable over the combined teachings of Ni, Chang, Murugesh, Arami, Goodyear, Ballance and Powell; and claims 51 through 55 as unpatentable over the combined teachings of Ni, Chang, Murugesh, Arami, Goodyear, Ballance and Hassan.[3]

We determine that Ni would have disclosed to one of ordinary skill in this art removable injectors as illustrated in **FIGs. 1** and **3a-c** which can have cylindrical and/or conical side surfaces extending axially from an axial end surface, wherein the side surfaces and/or end surfaces can have on-axis and/or off-axis outlets that can provide sonic or supersonic flow and are in fluid communication with a common gas supply through a central passage, and wherein the off-axis outlets can inject gas at an acute angel relative to the plane parallel to the exposed surface of the substrate. *See above* pp. 9-10.

The principal difference between the claimed injectors encompassed by representative claims 1, 5, 7 through 9, 15, 39, 41, 42 and 51, as illustrated in specification **Figs. 1** and **2a-c**,

[3] The examiner applied Ni as a primary reference in combination with other references early in the prosecution of this application, see, e.g., the Office action mailed December 5, 2002, and materially changed the applied references upon substantial amendments to the claims in the amendment filed December 19, 2003.

and the injectors taught by Ni is the presence in the claimed injectors of an annular passage, which along with the central passage, separates the outlets into at least first and second sets, wherein each of the passages is in fluid communication with a gas line and the two gas lines are connected to a common gas supply line. It was known in the art at the time the claimed invention was made to divide the outlets in an injector into different sets, wherein each set of injectors is supplied through its own passage to a gas supply line having a flow controller, which along with the gas supply line for the other set(s) of injectors, can be in fluid communication with a common gas supply, in order to control the flow and ingredients of the gas to the substrate, as evinced by the injectors having central and annular passages providing fluid communication between different sets of outlets and a common gas supply in Chang, Murugesh, Arami, Goodyear and Ballance as we have discussed these references above (*see above* pp. 7-9 and 10).

Based on the substantial evidence in the combined teachings of Ni, Chang, Murugesh, Arami, Goodyear and Ballance, we determine that, *prima facie*, one of ordinary skill in this art would have found in the applied references the reasonable suggestion to modify the plasma processing system of Ni by modifying the gas injectors of the processing apparatus disclosed thereto to incorporate an annular passage in addition to the central passage providing separate fluid communication between respective sets of outlets, on-axis and/or off-axis, each with its own gas line having a flow controller, to a common gas source as required by claims 1 through 9, 11, 13, 14, 39, 41 through 50 and 56 through 61, in the reasonable expectation of adjusting the flow and ingredients of the gas supplied to the outlets as taught by Chang, Murugesh, Arami, Goodyear and Ballance. *See Dow Chem.*, 837 F.2d at 473, 5 USPQ2d at 1531-32; *Keller*, 642 F.2d at 425, 208 USPQ at 881-82; *see also O'Farrell*, 853 F.2d at 903-04, 7 USPQ2d at 1680-81.

Furthermore, with respect to claim 15, we determine that, *prima facie*, one of ordinary skill in this art would have further used an electrically conducting shield on the side surfaces of the injector of Ni as modified by the teachings of Chang, Murugesh, Arami, Goodyear and Ballance, in the reasonable expectation of minimizing plasma ignition as taught by Powell at col. 7, 57, to col. 9, l. 50, and **FIG. 5**, as found by the examiner (answer, pages 10-11), thus arriving

at the claimed plasma processing system encompassed by claim 15. With respect to claim 51, we determine that, *prima facie*, one of ordinary skill in this art would have further used sonic or supersonic outlets in the injector of Ni as modified by the teachings of Chang, Murugesh, Arami, Goodyear and Ballance, as taught by Ni and as further shown by Hassan, thus arriving at the claimed plasma processing system encompassed by claims 51 through 55.

We have again considered the arguments advanced by appellants in the brief and reply brief to the extent that they apply to the new grounds of rejection we entered above. We are mindful that, as appellants point out, Arami, Goodyear and Ballance are directed to so-called "showerhead" injectors (brief, page 20). However, the injectors of these references along with the cylindrical injectors taught by Chang and Murugesh all establish the knowledge in the art that an injector can be divided into different sections to regulate gas composition and flow.

Accordingly, having reconsidered appellants' arguments, including consideration of the objective evidence in the specification in light of appellants' arguments in the brief, as they pertain to the new grounds of rejection under 35 U.S.C. § 103(a) which we entered above, we remain of the opinion that the claimed invention is *prima facie* obvious over the combined teachings of Ni, Chang, Murugesh, Arami, Goodyear and Ballance and as further combined with Powell and with Hassan as we have applied these references to pending claims 1 through 9, 11, 13 through 15, 39, 41 through 45, 47 through 58, 60 and 61. Thus, the burden of going forward with respect to these grounds of rejection remains with appellants. *See generally, Oetiker*, 977 F.2d at 1445, 24 USPQ2d at 1444; *Piasecki*, 745 F.2d at 1472, 223 USPQ at 788.

Other issues

The new grounds of rejection that we enter above should be extended to claims 10, 40, 46 and 59 upon appellants' amending thereof to overcome the new ground of rejection under 35 U.S.C. § 112, second paragraph, which we entered above

The examiner's decision is affirmed-in-part, and we have entered new grounds of rejection pursuant to our authority under 37 CFR § 41.50(b) (2005).

This decision contains a new ground of rejection pursuant to 37 CFR § 41.50(b) (2005).

37 CFR § 41.50(b) provides "[a] new ground of rejection shall not be considered final for purposes of judicial review."

37 CFR § 41.50(b) also provides that the appellant, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

(1) *Reopen prosecution.* Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the proceedings will be remanded to the examiner. . . .

(2) *Request rehearing.* Request that the application be reheard under § 41.52 by the Board upon the same record. . . .

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(1)(iv) (2005).

AFFIRMED-IN-PART

37 CFR 41.50(b)

EDWARD C. KIMLIN)
Administrative Patent Judge)
)
)
)
CHARLES F. WARREN) BOARD OF PATENT
Administrative Patent Judge) APPEALS AND
) INTERFERENCES
)
)
CATHERINE TIMM)
Administrative Patent Judge)

Peter K. Skiff
Burns, Doan, Swecker & Mathis, L.L.P.
P.O. Box 1404
Alexandria, VA 22313-1404